Executive Summary

ES.1 Summary of Recommended Plan

The recommended Long-Term Control Plan (Recommended LTCP) presented in this report was developed based on the results of a comprehensive alternatives analysis and comprise various combined sewer overflow (CSO) abatement components. The major components are WWTP improvements, system optimization, removal of brooks from the combined sewer system, sewer separation, and CSO storage.

Implementation of the Recommended LTCP must be phased to avoid severe disruption of businesses, neighborhoods, and transportation; to sequence construction schedules; and keep rate increases to a reasonable level. Accordingly, the first phase of the Recommended LTCP proposed is a $165 million Phase II program over the next 20-years which will nearly triple sewer rates during this time period. The Phase II program encompasses several building blocks of the Recommended LTCP addressing major objectives of CSO reduction, public health issues, brook removal, and urban infrastructure renewal. The major components of the Phase II program are:

- $20 million for WWTP improvements;
- $3 million for system optimization;
- $65 million for removal of Cemetery Brook;
- $73 million in sewer separation; and
- $4 million for program assessment/reporting.

The expected performance and benefits of the Phase II program are:

- Reduction of annual CSO discharges by 70-percent;
- Elimination of the 3.2 million gallons per day (mgd) Cemetery Brook from the combined sewer system;
- Reduction in average daily flow to the WWTP by 12-percent;
- Provides relief for approximately 235 reported sewer backups;
- Provides relief for approximately 340 reported street flooding locations;
- Installation of approximately 19-miles of new drainage;
- Installation of approximately 18-miles of new/rehabilitated sewers; and
- Construction of approximately 25-miles of urban revitalization (i.e., roads, sidewalk, curbing, and paths).

ES.2 Phase I CSO Abatement Program

The city of Manchester is committed to solving its CSO issues and has been working to abate these problems for more than fifteen years. Through the investigations and alternatives analysis completed in the 1990s, the city developed and submitted in 1995 a LTCP to the United States Environmental Protection Agency (EPA) and the New Hampshire Department of Environmental Services (NHDES). In March of 1999, the city and the EPA entered into a negotiated Compliance Order (CO) that established a 10-year $58 million Phase I CSO abatement program (Phase I).

With the submission of this report, the city has completed all requirements of the CO on or ahead of schedule. Phase I reduced the volume of CSO discharges from the area west of the Merrimack River by more than 99-percent. In general, the west side is now controlled to about the 2-year peak hour intensity storm event and there is now less than one overflow per year on average. This exceeded the goal of the Phase I program which was to provide a 3-month level of CSO control for the four outfalls remaining on the west side. Also, during the implementation of Phase I, the city completed improvements beyond the CO requirements and fully separated two additional drainage basins.

All CSOs to the Piscataquog River upstream of Bass Island have been eliminated, immediately improving the river water quality. Manchester has established a park system along both banks of the river, which include athletic fields and walking trails. Residents use the river and the adjoining park area for recreation and swimming/ wading. Recreational uses of the river have increased as the city continues to promote the parks and improve the surface water quality in the area.

Construction of the Phase I program resulted in 53 miles of new or rehabilitated piping. The result was an upgrade to over 25 miles of roads, curbing and sidewalks, while most of the underground pipelines were replaced or rehabilitated. As part of development of this LTCP, a sewer questionnaire was sent out to all sewer users in the city. Numerous responses from property owners on the west side replied that through the implementation of the Phase I program, their sewer backups and/or street flooding has been resolved and thanked the city for addressing their concerns.

In addition to full separation and related activities, Phase I had many other significant impacts. Numerous and lasting environmental, education, and health benefits were realized through the Supplemental Environmental Projects Program (SEPP). These included tangible benefits, such as preservation of open space (i.e., protection of rare Atlantic Cedar Swamp at Hackett Hill), development of environmental school curricula, and construction of stormwater and erosion controls. Less tangible benefits such as an improved understanding and appreciation of the natural environment and greater communication between city departments and outside organizations was also achieved.

ES.3 Revised LTCP

The purpose of this report is to update the city of Manchester's LTCP as required by the CO, with the primary focus being the remaining combined sewer drainage basins and overflows on the city's east side. Building on its Phase I success which achieved multiple benefits, the city has carefully prepared this LTCP which provides a comprehensive blueprint for upgrading the city's sewer system. This LTCP develops the foundation for further control of CSOs and relief public health issues (sewer backups and street flooding). The development of the LTCP encompasses a strategy which ensures that multiple goals are being achieved simultaneously by providing the greatest long-term overall benefit with several building blocks that address the city's major objectives of CSO reduction, public health issues, brook removal, and urban infrastructure renewal.

ES.4 Overview of Existing System

Collection System

There are 15 CSO outfalls remaining in the Manchester wastewater collection system and interceptor network. Of the 15 remaining CSO outfalls, 2 discharge to the Piscataquog River (adjacent to Bass Island and immediately upstream of the river's confluence with the Merrimack River), 2 discharge to the Merrimack River from the west side of the city, and 11 discharge to the Merrimack River from the east side of the city.

Because the original collection system in Manchester was constructed as a combined system, the remaining combined areas are generally the oldest in the city. The majority of the combined system exceeds 75-years in age. In fact, the city has over 100 miles of sewers over 100-years old, with the oldest sewers dating back to the early 1870's. As a result, the frequency of major pipe failures has been increasing over the past decade resulting in costly emergency repairs. The issues that exist in Manchester's collection system can essentially be categorized as follows:

- Capacity Related Issues – *Street flooding and sewer surcharging/basement backups.* While street flooding and sewer backups typically result from two separate issues (insufficient drainage or sewer capacity), in combined sewer systems there is only one pipe to convey both the sanitary and stormwater flow. Thus, the drainage capacity (flooding) and sewer capacity (surcharging/basement backups) issues originate from one pipe and alternatives to resolve issue must consider the other.

- Age/Maintenance Related Issues – *Pipe failures, root and grease buildup, etc.* These issues are more pronounced in the combined areas due to the age of the system and are typical of pipes for their vintage.

- Brook Conveyance/Treatment - Over time, five major brooks (Cemetery Brook, Stark Brook, Christian Brook, Mile Brook, and McShane Brook) on the east side of the city were incorporated into the city's combined system as the city expanded beyond the banks of the Merrimack. Based on recent flow metering data, the brook flow in the collection system accounted for approximately 18-percent of the average

daily flow treated at the WWTP over the last year.

The capacity and age related issues are critical from both a public health and environmental perspective. Currently thousands of residents are subjected to backups of raw sewer flowing into their basements and streets during storm events. Relieving this public health risk and environmental problem is a top priority goal of the city's plan.

Wastewater Treatment Plant

The city owns and operates a conventional secondary WWTP that was constructed in 1975 and received several major upgrades in the mid-1990s. Treated wastewater is discharged through an outfall to the Merrimack River. The WWTP has an average day design capacity of 34 mgd and a peak wet weather flow capacity of approximately 65 mgd. This wet-weather treatment capacity includes the flow through secondary treatment (about 34 mgd) and the high-flow conduit (about 31 mgd) that was constructed during Phase I. The average daily flow to the treatment plant from January 1, 2004 to June 30, 2007 was 23.1 mgd and in 2009 the plant average 27 mgd. The projected year 2030 average daily flow to the WWTP is 32.1 mgd (as published in the city's May 2009 *Wastewater Treatment Facility Draft Facility Plan Report*).

CSO Characteristics

A computerized model of the sewer and interceptor pipe collection system was originally developed using the EPA Stormwater Management Model (SWMM or model) in the early 1990s and has been periodically updated/calibrated since then. This proven model was updated, calibrated, and verified to field conditions for this LTCP using flow information collected during flow monitoring programs performed in 2008 and 2009. The SWMM was used to simulate existing conditions and key "design storm" conditions (reflecting various return intervals of storms, i.e., 1-month and 6-month return frequencies, etc) to identify the annual CSO discharge characteristics for Manchester's combined sewer system under rainfall events. Using the model, CSO control alternatives and strategies were developed and evaluated to determine the various benefits and costs of each.

The following summarizes the key CSO discharge characteristics with average annual rainfall conditions for the projected 2030 baseline wastewater and infiltration/inflow (I/I) conditions, based on the SWMM simulations for average annual conditions:

- 1,647 million gallons of wet weather combined sewage are projected to enter the sewer system annually;
- 1,367 million gallons (83-percent) of this project volume are projected to be captured and treated at the WWTP;
- 280 million gallons (17-percent) are projected to overflow untreated to receiving waters; and
- An estimated 49 rainfall events result in overflows in an average year.

Public Health and Water Quality Issues

The principal receiving water for Manchester's CSO discharges is the Merrimack River. The CSOs are point source discharges and are subject to the requirements of the EPA's CSO Policy, the state's CSO Control Strategy, and the state's Water Quality Standards. The CSO discharges do not meet the criteria for Class B waters and the Merrimack River through Manchester, NH is on the state 303(d) list of impaired water bodies for violations of bacterial water quality standards during and immediately following storm events.

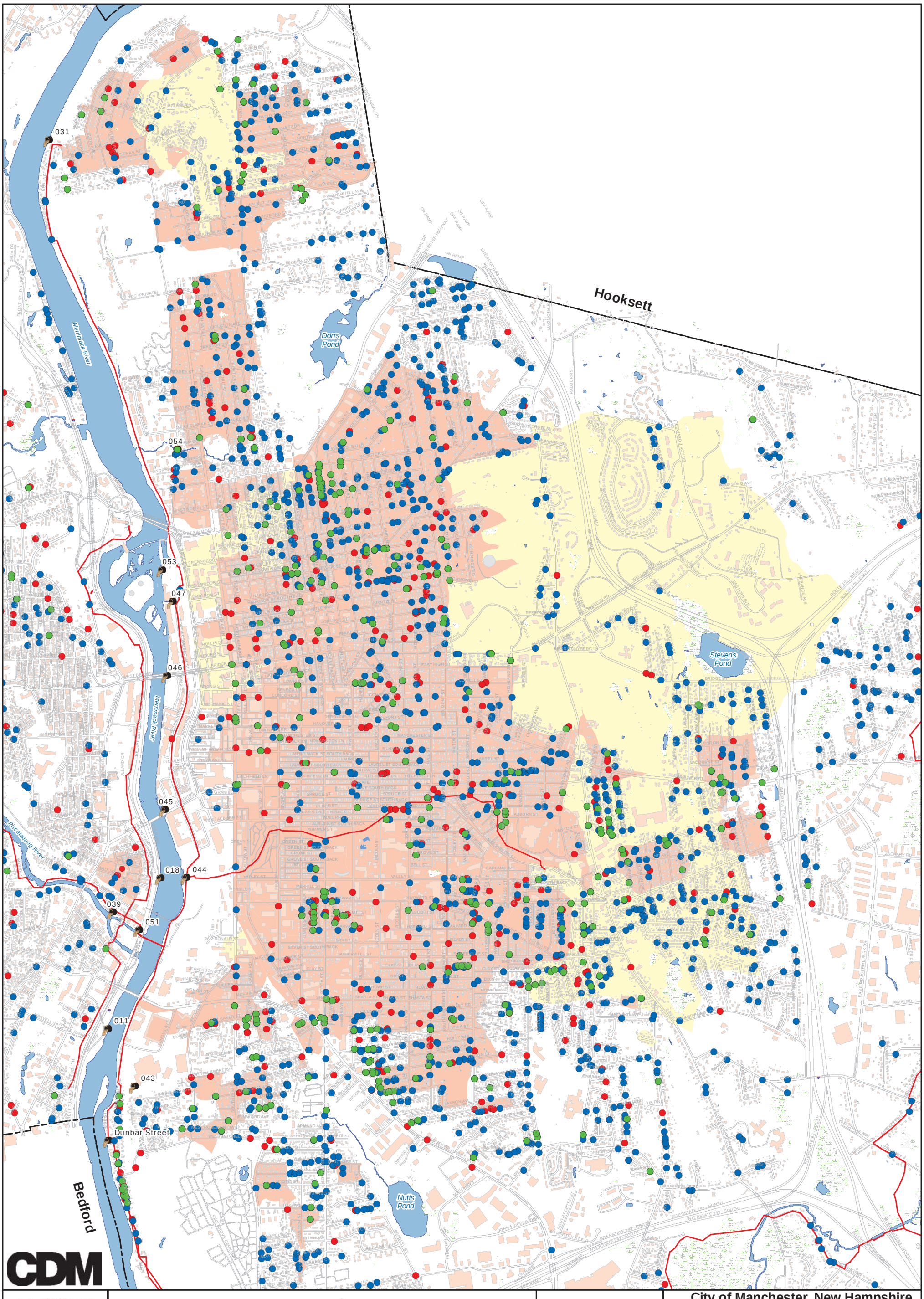
Water quality issues are not just limited to receiving waters. The city's aging infrastructure has begun to fail with increasing frequency and basement backups and street flooding have become more pronounced throughout the combined areas of the collection system. To better understand the public's experience, problems, and concerns with the existing collection system, the city distributed a sewer questionnaire (twice as an insert with the sewer bill) to the approximately 24,000 sewer customers in the city. The information generated from the 42-percent of the sewer users that responded provided invaluable detail of the water quality related deficiencies within the collection system. More than 920 basement backups and over 2,200 locations of street flooding were reported by sewer customers city-wide. Given that the return rate of the sewer questionnaire was 42-percent, there are likely more basement backups and street flooding locations from the 58-percent of sewer users that did not respond to the questionnaire. Therefore, the number of basement backups and street flooding presented throughout this report are considered conservative compared to the actual total that may be out in the collection system. The following is a brief summary of the questionnaire responses returned from sewer customers located in the remaining combined areas of the city:

- More than 11-percent (713) of the sewer customers (that returned questionnaires) reported that they have experienced a backup from the sewer into their basement.

- Approximately 27-percent (1,690) of the sewer customers (that returned questionnaires) reported that they have observed street flooding near their property.

Figure ES-1 shows the widespread distribution of sewer backups and street flooding. It can be seen from these figures that the problem is especially pronounced throughout combined areas of the collection system and thus, the risk to public health is considerable. In addition, many of these citizens live in low/moderate income households, so this is also an environmental justice issue. This suggests that even with downstream controls (i.e., CSO storage or treatment), if the capacity constraints of the upstream system are not addressed, these significant public health risks will persist.

Human exposure to sewerage in homes and streets is both a public safety issue and a significant health risk that may represent a more immediate threat to public health in Manchester than the CSO discharges to waterways. The CSO abatement techniques to be utilized as part of this revised LTCP must consider resolutions to both the upstream and downstream public health risks.



Legend

- 047 Remaining CSO and NPDES #
- Sanitary Interceptor
- Town Lines
- Roads
- Wetland Areas
- Water Bodies
- Combined Drainage Area
- Recombined Drainage Area
- Street Flooding Reported
- Sewer Backup Reported
- Sewer Backup and Street Flooding Reported

N W E S

0 2,000 Feet

City of Manchester, New Hampshire
Revised Long-Term CSO Control Plan
March 2010
Sewer Backups and Street Flooding Reported from Questionnaire Results
Figure ES-1

ES.5 Recommended LTCP and Proposed Phase II CSO Abatement Program

Based on the anticipated construction sequence (detailed in Section 11), it is anticipated that the implementation of the entire Recommended LTCP will take the city approximately 40-years to construct in a controlled and cost-effective manner. Given this length of schedule, the future implementation of the Recommended LTCP should be phased.

As a benchmark, Manchester's Phase I program included approximately $58 million of projects performed over 10-years. The costs of the Phase I program escalated from the midpoint of implementation (2004) would be about $74 million in 2010. This is an average of about $7.4 million per year in project implementation cost. Completing the entire Recommended LTCP with a similar annual expenditure rate would require an implementation schedule of about 47-years.

Additionally, implementation of the entire Recommended LTCP in a short duration (20 to 30-years) would cause sewer rates to increase by a factor of four over 20-years and would cause rates to approach 2.5-percent of median household income. This will further financially burden system users that have absorbed a 107-percent rate increase from 2007 to 2010 to meet the ongoing needs of the existing sewer infrastructure, the financial obligations with the Phase I program, and partially in preparation of the Phase II program. Further, if the entire LTCP was performed in 20 to 30-years, the amount of disruption to the city streets for all the sewer separation would create adverse conditions for residents and businesses. Lastly, a phased program allows the long-term plan to be updated every ten years (similar to the Phase I program) to ensure the program goals and objectives are being achieved cost-effectively. This will also allow the LTCP to respond to any new regulatory requirements that may be implemented, evaluate new innovative construction techniques, and consider the current economic conditions. Also, ten years represents two NPDES permit cycles which will allow the LTCP to react to any additional WWTP regulatory requirements.

Therefore, based on the construction sequencing and timing issues, assessment of Phase I, and the financial implications, implementation of the Recommended LTCP should be phased. Accordingly, the first phase of the Recommended LTCP proposed is a Phase II program over the next 20-years. The Phase II program is estimated to have a project cost of $165 million. With an implementation period of 20-years, this equates to an average project cost of approximately $8 million (2010 dollars) per year. Figure ES-2 shows the major components of the Phase II program, which include:

- $20 million for WWTP improvements;
- $3 million for system optimization;
- $65 million for removal of Cemetery Brook;
- $73 million in sewer separation; and
- $4 million for program assessment/reporting.

Phase II
Separate North Chestnut/
Elm Street South Area

Phase II
Install Modulating Gate
for Real-Time Control of
Cemetery Brook

Phase II
WWTP Improvements

Phase II
Separate Areas Adjacent
to New Cemetery Brook Drain

Phase II
New Cemetery
Brook Drain (CBD)

Stark Brook
Christian Brook
McShane Brook
Mile Brook
Cemetery Brook

031
054
053
047
046
045
044
018
039
051
011
043
052
050

Merrimack River
Piscataquog River
Dorrs Pond
Stevens Pond
Nutts Pond
Crystal Lake
Pine Island Pond

Hooksett
Goffstown
Bedford
Bedford
Dunbar Street

CDM

Legend

- 047 Remaining CSO and NPDES #
- Existing Sanitary Interceptor
- Town Lines
- Roads
- Existing Drains
- Separation Area for Proposed Phase II of Recommended LTCP
- Separation Area for Future Phases of Recommended LTCP
- Remaining Combined Area
- Brooks Entering System
- New Drain
- New Cemetery Brook Drain

N W E S

0 2,500 Feet

City of Manchester, New Hampshire
Revised Long-Term CSO Control Plan
March 2010

Proposed Phase II Program
Figure ES-2

Figure ES-3 provides the implementation schedule for the $165 million 20-year Phase II program. A summary of the each of the major components included in the Phase II program is provided below.

WWTP Improvements

The city is completing a WWTP facility plan which includes proposed upgrades to address equipment age and efficiency issues. Upon completion of the upgrades, the peak day secondary treatment design capacity is expected to be 48 mgd and the peak wet weather capacity is expected to be 83 mgd. The city estimates that approximately $20 million of improvements are directly related to a capacity increase and therefore considered CSO-related and included in the Phase II program.

System Optimization

System optimization is identified as a first step to reduce sewer overflows in the US EPA's August 2004 report, titled "*Report to Congress, Impacts and Control of CSOs and SSOs*." Real-time control is a prominent technology used to achieve system optimization. The Phase II program includes maximizing use of the existing interceptor capacity by controlling the Cemetery Brook CSO regulator structure with a modulating gate to control flow contributions to the East Interceptor North. The estimated project costs for implementing this CSO abatement alternative is $3 million.

Brook Removal

Five brooks are connected to the collection system. These brooks reduce the available capacity in the combined sewer system and increase O&M costs at the WWTP. Cemetery Brook is by far the largest brook in the collection system and contributes as much as 55 mgd of peak flow (based on metering results from the last year). The implementation of the Phase II program will eliminate Cemetery Brook from the sewer collection system with the installation of a $65 million Cemetery Brook Drain. Construction of this drain is also a necessary precursor to solving the capacity related backups and street flooding.

Sewer Separation

This revised LTCP was developed by identifying subareas of the city where separation would have the greatest benefits while being cost-effective. The subareas identified with the most need of separation ranked high in the prioritization of the problems (sewer backups and street flooding), age of sewer system, and expected CSO reduction through separation. The Phase II program includes $73 million in sewer separation in the Cemetery Brook (044), Granite Street (045), and Tannery Brook (043) CSO basins that will address nine of sixteen high priority areas (the top third of the separation subareas).

Program Assessment/Reporting

To ensure the successful implementation of the Phase II program a $4 million allowance has been included for continual program assessment and reporting over the duration of the program. It is recommended that the LTCP be updated every ten years to ensure the program goals and objectives are being achieved in a cost-effective

CSO Basin	Project Description	Estimated Project Cost [1,2] (Millions $s)	Project Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
All	Program Assessment and Reporting	$2.4	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
WWTP	Increase Treatment to 83 MGD	$20.0	■	■	■	■	■	■	■	■	■	■	■	■									
Cemetery Brook	System Optimization with Real-Time Control	$3.0	■	■	■	■																	
Cemetery Brook	Cemetery Book Drain	$65.0	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
Cemetery Brook / Granite Street	Sewer Separation of North Chestnut / Elm South Area	$12.3		■	■	■	■	■	■														
All	Update LTCP	$0.5										◆											
Cemetery Brook / Tannery Brook	Sewer Separation to Cemetery Brook Drain	$60.8									■	■	■	■	■	■	■	■	■	■	■	■	
All	Update LTCP	$1.0																					◆
	TOTAL	**$165.0**																					

Notes: [1] All estimated project costs are in January 2010 dollars

[2] All estimated project costs include a 45 percent allowance for engineer and contingences

◆ Milestone

CDM

Figure ES-3
Proposed Implementation Schedule - Phase II CSO Abatement Program

manner. This will also allow the LTCP to respond to any new regulatory requirements that may be implemented. Lastly, ten years represents two NPDES permit cycles which will allow the LTCP to react to any additional WWTP regulatory requirements.

ES.6 Financial Analysis

The Phase II program would be paid by the sewer enterprise fund and supplemented by any financial support received from state and federal government. Under the $165 million 20-year Phase II program, revenue requirements are projected to increase from $13.2 million in FY 2010 to roughly $45.4 million in FY 2030. This is equivalent to an average annual increase of about 5-percent. These projections include $131 million (2010 dollars) in anticipated capital improvements for non-CSO system improvements in addition to the $165 million in spending on the Phase II program. The annual increases in revenue requirements drive the increases in annual household sewer bills, with the average household cost for the average city resident projected to increase by a factor of nearly three from $439 in FY 2010 to $1,263 in FY 2030 under this program. This will further financially burden system users that have absorbed a 107-percent rate increase from 2007 to 2010 to meet the ongoing needs of the existing sewer infrastructure, the financial obligations with the Phase I program, and partially in preparation of the Phase II program. Figure ES-4 shows the growth in the projected annual household bill over the forecast period.

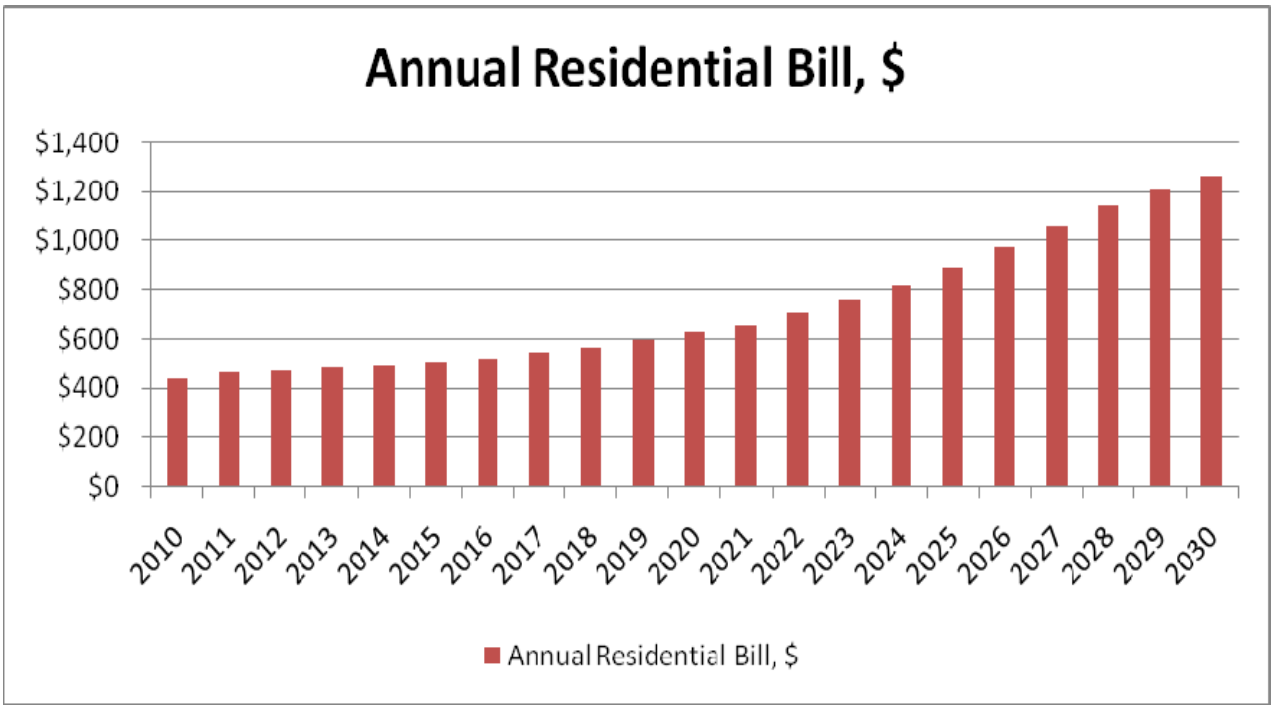


Figure ES-4
Annual Household Bill for Proposed Phase II

ES.7 City Support of Phase II Program

Upon selecting the city's Recommended LTCP and proposed Phase II program, various meetings were held with the city's Mayor and Aldermen to discuss the details and necessity of the CSO abatement program and the anticipated financial impact that the Phase II program will have on the city's rate payers. These meetings were imperative as submitting a LTCP without the support of the Board of Mayor and Alderman could have consequences if they did not approve of the recommended plan. A formal presentation was made to the city's Community Improvements Programs (CIP) Committee on March 1, 2010. The culmination of the meetings was a vote of support by the Board of Mayor and Aldermen on March 2, 2010 for the submission of this LTCP report and the future implementation of a $165 million 20-year Phase II program. A copy of the official approval letter, presentation, and other related handouts are included in Appendix P.

ES.8 Performance and Benefits of Recommended Plan

The true success of the completed program is often measured by the multiple benefits achieved through its implementation. Measurable goals of the implementation of the Phase II program include improvements to receiving water quality with CSO reduction, abatement of public health issues (sewer backups and street flooding), reduction in flow to the WWTP, and urban revitalization. Each of these is summarized in this section.

Receiving Water Quality Benefits

Table ES-1 summarizes the estimated average annual reduction in CSO frequency and volume achieved by the Phase II program, which will reduce the average annual CSO volume by about 70-percent (from 280 million gallons to 84 million gallons).

Alternative	Estimated Average Annual CSO Frequency (Events/Year)	Estimated Average Annual CSO Volume (MG)
Existing Conditions	44	258
Projected 2030 Baseline Conditions	49	280
Implementation of Phase II	24	84
Percent Reduction after Phase II Program	**49 %**	**70 %**

Table ES-1
Estimated CSO Frequency and Volume Reduction

Sewer Backups and Street Flooding Reduction

From a public health and environmental justice perspective, this may be the most important aspect of this plan. Basement backups represent perhaps the most significant risk of human exposure to sewage in Manchester and are a high priority for the city to address. The Phase II program is expected to conservatively address about 235 of these reported sewer backup locations in the combined/re-combined areas. Given that the return rate of the sewer questionnaire was 42-percent, there are likely more basement backup locations in the project area from the 58-percent of sewer users that did not respond to the questionnaire. Also, over time through the implementation of the city's CMOM program, it is expected that the remaining occurrence of these backups in both combined and separated areas will be further reduced.

Street flooding is both a public safety issue and a health risk because the flooding often contains sewage. The Phase II program is expected to conservatively address about 342 of these reported street flooding locations in the combined/re-combined areas. Given that the return rate of the sewer questionnaire was 42-percent, there are likely more street flooding locations in the project area from the 58-percent of sewer users that did not respond to the questionnaire. Also, over time through the implementation of the city's stormwater program, it is expected that the remaining occurrence of these street flooding locations in both combined and separated areas will be further reduced.

Reduction in Flow to WWTP

Eliminating brooks from the sanitary sewer system will reduce the volume of wastewater discharged by the treatment plant, reduce the cost to transport and treat sewerage, and would free up valuable treatment capacity in the collection system and at the WWTP. This will allow for the anticipated future increase in wastewater flow contributions from Manchester and the neighboring towns over the next 20-years. The implementation of the Phase II program will eliminate 65-percent of this brook flow with the separation of Cemetery Brook. This will reduce the average daily flow to the WWTP by approximately 12-percent.

Urban Revitalization

As part of the development of this revised LTCP, a series of meetings were conducted to identify additional city programs that could provide benefit or could be coordinated with the CSO program. The meetings had two major objectives:

- Inform the departments of the long-term CSO abatement program; and
- Determine how each department's plans for future work (i.e., roadway maintenance, park improvements, streetscaping, underground utility installation/rehabilitation, etc.) can be completed in concert, where applicable, with the construction required for this program.

Based on the results of these meetings and discussions, the city has various ongoing programs, within multiple departments, that are focused on meeting the shared visions for redevelopment and urban revitalization of Manchester. Whether the program is required to meet regulatory requirements or simply improve the quality of life of the city's residents, each of these programs have implementation costs. An important goal in developing this LTCP was to ensure that the future program is integrated with other ongoing projects and considers the financial implications of all the projects on the city's rate payers. The CSO abatement program will likely be one of the largest capital projects that the city has ever implemented. A project of this magnitude will need to be coordinated at many levels to ensure the visions for urban redevelopment and revitalization are met making Manchester a better place to work and live.